GROUNDWATER TECHNOLOGY, INC.

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HYDROGEOLOGIC ASSESSMENT
FORMER UNDERGROUND STORAGE TANK LOCATIONS

Scott Paper Company
Front and Avenue of the States
Chester, Pennsylvania

Submitted to:

Scott Paper Company
Front and Avenue of the States
Chester, Pennsylvania

Submitted by:

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1.0 Introduction

On behalf of Scott Paper Company, Groundwater Technology, Inc. has performed a hydrogeologic investigation at the Scott Paper Company Operations Facility in Chester, Pennsylvania.

In September and October, 1989, eight underground storage tanks were abandoned in place or removed from the Scott Paper Company's Chester Operations facility. These tanks had been used to store the following products:

- No. 2 fuel oil
- No. 6 fuel oil
- Gasoline
- Kerosene
- Mineral oil
- Waste oil (hydraulic fluids)
- Commercial grade xylene solvent (two tanks)

During the removals, contaminated soils were encountered in the vicinities of the tanks. These soils were excavated to the extent possible and are not discussed here. The tank removal activities have been presented in a report entitled "Underground Tank Removal Report for Scott Paper Company, Chester Operations, Chester, PA" prepared by Buckhart-Horn, Inc. (November, 1989).

Based on the results of the tank removal, the Pennsylvania Department of Environmental Resources (PADER) requested that Scott Paper complete a hydrogeologic investigation in the vicinity of the former tanks. This report presents the results of the investigation.

2.0 Background Information

2.1 Land Usage

The Chester Operations Facility of Scott Paper Company is a paper manufacturing and distribution plant. The plant manufactures tissue products, particularly toilet paper, tissues, paper towels, and napkins. The facility is located in the center of the city of Chester, PA adjacent to the Delaware River. The entire riverfront portion of Chester as well as neighboring towns along the Delaware River from Claymont, Delaware northward is a heavily industrialized area. Several refineries are located in Marcus Hook just to the south. In the immediate vicinity of the Scott facility are a meat packing plant, a Philadelphia Electric Company Substation and a Penn Shipbuilding facility. The Scott facility and surrounding area are shown on the Site Location Map in Figure 1, Appendix A. A more detailed map of the Scott plant is shown on the Facility Map in Figure 2, Appendix A.

Due to the industrial and urban land usage, the site and surrounding area have been graded to a topographically level surface. For the most part, the land surface is covered with buildings or paving in the form of roads, sidewalks and parking lots. Surface drainage would generally be towards the Delaware River. However, as is typical of most urban areas, most surface runoff is collected by a comprehensive storm sewer system.

2.2 Regional Geology

The Scott Paper property is located within the Physiographic Province known as the Atlantic Coastal Plain. The geology of the Coastal Plain consists of several thousands of feet of unconsolidated materials ranging in age from Cretaceous to Holocene (recent). The deposits range in texture from clays to coarse gravels. The geology beneath the Scott Paper facility has

been mapped as the Trenton Gravel, a Pleistocene age deposit of gravelly sand with varying interbeds. Also included in this deposit for mapping purposes are Holocene alluvial and swamp deposits. It is likely that these alluvial deposits are present beneath the site as a result of reworking and deposition by the Delaware River.

Although the site lies within the Atlantic Coastal Plain, it is very near the northern boundary with the adjacent Piedmont Province. The Piedmont is made up of highly weathered metamorphic rocks of Paleozoic age. Due to the proximity of the site to the edge of the Coastal Plain, it is likely that the metamorphics or their weathering products would be encountered at relatively shallow depth beneath the site. That is, although very thick deposits are typical of most of the Coastal Plain, much thinner deposits would be expected in the vicinity of the Chester plant.

2.3 Groundwater Usage

The area of Chester in the vicinity of the Scott Paper facility is serviced by the Chester Water Authority, a municipal water supply company. There are no known groundwater users in the area. The site lies right on the Delaware River. Regional groundwater flow is expected to be towards the Delaware River and/or Chester Creek which bisects the property. Except for any underground utilities on the plant property, the only potential receptors for any contamination originating on the site are the two surface water bodies.

3.0 Investigation Methodology

Prior to the initiation of the field investigation program and consistent with OSHA regulations (29 CFR 1910.120), a site safety plan was prepared by a GTI industrial hygienist. The site safety plan addresses protocol to be performed during field work to protect worker health and safety. All field work has performed in accordance with the site safety plan.

The investigation surrounding the former storage tanks consisted of the following general scope of work:

- Installation of one monitoring well adjacent to and downgradient from each of the former tanks.
- Installation of one monitoring well near an upgradient property line to determine background characteristics.
- Submittal of one soil sample from each borehole for laboratory analyses.
- Collection and analysis of three rounds of groundwater samples collected at least one month apart.
- Gauging of water levels in all wells and the Delaware River on at least three occasions to determine whether any separate-phase petroleum is present and to calculate groundwater gradients and inferred direction of groundwater movement.

Each of these work steps is detailed below.

3.1 Monitoring Well Installation

Nine monitoring wells (designated MW-2 through MW-10) were installed by Groundwater Technology, Inc. on the Scott property; one well was installed adjacent to each of the former tank locations, and one was installed as an upgradient background well. All wells were installed using hollow stem augering techniques although two of the wells required the use of remote

drilling techniques using a detachable mast and hydraulic umbilical due to limited accessibility. Each borehole was advanced to auger refusal or a depth of fifteen feet, whichever was encountered first. As the water table was encountered at a depth of approximately three to six feet in all boreholes, all wells adequately penetrated the water table.

Four-inch diameter wells were placed in each borehole. Due to the shallow water table and the expected tidal fluctuations, all wells except MW-9 were screened to the surface. The annulus between the well and the borehole was backfilled with a compatible sand pack. In wells MW-4 and MW-8, a sand pack was not installed due to the coarse nature of the existing soil material. Each well was capped with a water tight locking cap and man-way cemented in place. Each well was developed, and elevations were surveyed.

One pre-existing monitoring well, MW-1, was not installed by Groundwater Technology, Inc. but was used as an additional data collection point.

3.2 Soil Sample Collection

During drilling, split spoon samples were collected at the ground surface and at five-foot intervals thereafter. Many of the soil samples were screened with a portable flame or photoionization detector (OVA). The soil material making up each sample was then described on a well log. All samples were stored on ice until received by the laboratory.

One sample from each borehole was submitted for laboratory analysis. The sample exhibiting the highest reading on the OVA, or the sample from the water table was selected. At the completion of drilling, the selected soil samples were packed in appropriate containers, stored on ice and shipped to the

laboratory. The analyses performed on each sample were based on the contents of the nearby tank. Samples were analyzed for benzene, toluene, ethylbenzene and xylenes (BTEX) by EPA Method 8020, for polychlorinated biphenyls (PCB's) by EPA Method 8080, and for total petroleum hydrocarbons (TPH) by a modified EPA Method 8015. EPA Method 8015 is a gas chromatographic analysis. Sample chromatograms are compared to chromatograms for several standard petroleum products. These include gasoline, No. 2 oil (diesel), No. 6 oil, lubricating oil, mineral spirits, and kerosene. For this project, a mineral oil standard was also added.

3.3 Groundwater Sampling

On three separate occasions (February 6, April 25, and May 30, 1990), complete rounds of groundwater samples were collected from monitoring wells MW-2 through MW-10 and submitted for laboratory analysis. Prior to sampling, three to five well volumes of groundwater were removed from each well. This standard purging ensures that collected samples are representative of aquifer conditions. Each groundwater sample was placed in appropriate containers and stored on ice for shipment to the laboratory.

For the initial sampling round, the analyses performed on each groundwater sample were based on the contents of the nearby former tank. The analyses performed on later rounds were also based on the results of the previous rounds. Groundwater samples were analyzed for BTEX by EPA Method 8020, and for TPH by the modified EPA Method 8015 as described above. In addition, two samples were analyzed for semi-volatile compounds by EPA Method 8270.

3.4 Well Gauging

In order to determine accurate groundwater elevations, the location and elevation of each well head were surveyed by a professional land surveyor to an accuracy of 0.01 feet.

On at least three occasions, the wells and the Delaware River were gauged. Gauging was performed using an ORS Environmental Equipment interface probe which measures the depth to water and hydrocarbon thickness to an accuracy of 0.01 foot. Based on the gauging data, a groundwater contour map was generated.

4.0 Results of Investigation

On January 19, 22, and 23, 1990 Groundwater Technology supervised the installation of nine monitoring wells (MW-2 through MW-10) at the Scott Paper facility. In addition, one pre-existing monitoring well (MW-1) was used as a data collection point. All well locations are shown on the site map in Figure 3, Appendix A. Table I presents the location of each well relative to the nearby former tank.

TABLE I

Well Locations

WELL NO.	ADJACENT FORMER TANKS
MW-1 (pre-existing)	Above Ground Bulk Fuel Storage
MW-2	No. 6 oil (abandoned in place)
MW-3	Waste Oil
MW-4	Xylene Tank (fiberglass)
MW-5	Xylene (fiberglass) and Kerosene
MW-6	Kerosene and Mineral Oil
MW-7	Gasoline
MW-8	Xylene (Rail Car)
MW-9	Upgradient
MW-10	Diesel (No. 2) fuel

4.1 Geology

Soil materials encountered during drilling included:

- coarse process stone fill material (tank field backfill)
- dark gray to black clay and silt (fly ash fill)
- orange-brown sandy fill material
- reddish brown sand and gravel (river deposit)

Process stone was only encountered where tanks had been removed. The orange-brown material was present in the up-gradient borehole (MW-9) on the northern portion of the property. The river deposits were encountered only at depths exceeding twelve feet. Fly ash fill was the dominant material encountered during drilling activity across the rest of the site.

Well logs showing stratigraphic and construction details are included in Appendix B.

4.2 Hydrogeology

The monitoring wells and the water level in the river were gauged on four occasions between February and May, 1990. The collected gauging data are presented in Appendix C. Separate-phase petroleum has consistently been detected in MW-1. A petroleum recovery system has been installed in this area by Treigel Associates, Inc.

Depth to groundwater across the site ranged from 3 to 8 feet below grade. The gauging data from February 14, 1990 has been used to generate a groundwater contour map. This map is presented in Figure 4, Appendix A. The data from the two other gauging events show similar groundwater elevation patterns. Regional and local groundwater flow is towards the Delaware River and/or Chester Creek. This trend is demonstrated in the group of wells (MW-1, MW-2 and MW-10) adjacent to the River. However, the presence of large asphalted areas and the extensive basement complex of the plant appear to interrupt and alter natural flow paths over a large portion of the site. Near the group of former tanks (MW-4 through MW-8) groundwater appears to flow to the east, parallel to Delaware River. Buildings 20 and 21, located directly south (towards the river) from these wells are known to have basements that intersect the water table. Shallow groundwater is therefore forced to flow around this obstruction.

In addition, the coarse backfill used in this area and the unpaved ground surface may be causing localized mounding of the water table in this area. These factors appear to be resulting in groundwater flow to the east around the building and possibly to the north due to the mounding. It is unknown how far this anomaly extends.

4.3 Soil Analytical Results

Selected soil samples collected during drilling were submitted for laboratory analysis. The laboratory results are included in Appendix D, and are summarized on Table II below.

None of the analytes were detected in the upgradient soil sample (MW-9) or the soil sample downgradient of the No. 2 oil tank (MW-10). A PCB concentration of 0.59 parts per million (ppm) was detected near the former location of the waste oil tank (MW-3) A concentration of 420 ppm of TPH as kerosene was detected near the abandoned No. 6 oil tank (MW-2); 490 ppm of TPH as lube oil was detected near the gasoline tank location (MW-7). Adjacent to the xylene and kerosene tanks (MW-4, MW-5 and MW-8), up to 120 ppm of ethylbenzene, 590 ppm of total xylenes and 670 ppm of TPH as kerosene were detected.

Table II

SOIL ANALYTICAL RESULTS

January 19 to January 23, 1990

Sample	Depth Collected (ft)	Benzene (ppm)	Toluene (ppm)	Ethyl-benzene (ppm)	Xylenes (ppm)	PCB's (ppm)	TPH (ppm)	TPH Standard
MW-2, SS-2	5 to 7	nd	nd	nd	nd		420	kerosene
MW-3, SS-2	approx. 4					0.59	nd	
MW-4, SS-2	5 to 7	nd	nd	nd	1.4			
MW-5, SS-2	10 to 12	nd	nd	120	590		480	kerosene
MW-5, SS-1	6 to 8						nd	
MW-7, SS-1	5 to 7	nd	nd	nd	nd		490	lube oil
MW-8								
MW-9, SS-1	5 to 7	nd	nd	nd	nd		nd	
MW-10, SS-1	5 to 7	nd	nd	nd	nd		nd	

nd - not detected

Blanks indicate no analysis performed

MW-8: no soil recovery during drilling

Refer to text (Section 3.2) for explanation of TPH standard

4.4 Groundwater Analytical Results

On three occasions, groundwater samples were collected from the monitoring wells and submitted for laboratory analysis. The laboratory results are included in Appendix E and are summarized in Table III.

The distribution of dissolved hydrocarbons near each former tank location is discussed below.

No. 6 Oil Tank

Dissolved hydrocarbons were not detected in two of the three samples collected from MW-2. In May, 1990, 63 ppb of TPH as lube oil was detected.

Waste Oil Tank

Toluene and xylenes were detected in one groundwater sample from MW-3 at concentrations of 45 parts per billion (ppb) and 93 ppb respectively. In addition, TPH was detected in all three samples ranging from 71 ppb to 12,000 ppb as kerosene.

Xylene Tanks

Three wells (MW-4, MW-5, and MW-8) are located near the former xylene tanks. Dissolved hydrocarbons have been detected in all three of these wells. The concentrations of the aromatics (BTEX) indicate generally higher concentrations of xylenes and ethylbenzene relative to the concentrations of benzene and toluene. Commercial grade xylene commonly consists of a xylene-ethylbenzene mixture; it is likely that benzene and toluene could also have been present as contaminants in the virgin solvent. Benzene and toluene concentrations ranged from not detected to 43 ppb. Ethylbenzene concentrations ranged from 19 ppb to 1,500 ppb; xylene from 95 ppb to 8,800 ppb.

Dissolved TPH was also detected in these wells. Two different TPH standards were recognized. In each chromatogram xylene/ethylbenzene peaks were observed. Because these compounds are present in gasoline, these peaks were quantified by the laboratory as gasoline. The other standard utilized was kerosene. Concentrations of TPH as gasoline ranged from 17 ppb to 4,400 ppb; TPH as kerosene

Table III

GROUNDWATER ANALYTICAL RESULTS

Well/ Sampling Date	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	TPH (ppb)	TPH Standard
MW-2						
2/90					nd	
4/90					nd	
5/90					63	lube oil
MW-3						
2/90	nd	45	nd	93	12,000	kerosene
4/90					71	kerosene
5/90					9,600	kerosene
MW-4						
2/90					25/2,900	gasoline/kerosene
4/90	nd	nd	32	120	17/57	xylenes/kerosene
5/90	6.4	6.5	19	95	130/1,300	xylenes/kerosene
MW-5						
2/90	nd	nd	500	8,800	240/2,400	gasoline/kerosene
4/90	nd	nd	460	5,000	440/130	xylenes/kerosene
5/90	3.7	nd	430	2,300	4,400/2,400	xylenes/kerosene
MW-6						
2/90					86	kerosene
4/90	nd	0.5	nd	nd	nd	
5/90	0.5	nd	nd	nd	nd	
MW-7						
2/90	nd	nd	nd	nd	nd	
4/90	nd	nd	nd	nd	nd	
5/90	0.8	nd	nd	nd	15	gasoline
MW-8						
2/90					690/12,000	gasoline/kerosene
4/90	43	25	1,500	2,600	2,600/180	xylenes/kerosene
5/90	33	22	970	2,600	3,600/1,100	xylenes/kerosene
MW-9						
2/90	0.4	nd	7.9	40	nd	
4/90	0.8	nd	nd	nd	nd	
5/90	0.6	nd	nd	3.9	nd	
MW-10						
2/90	nd	nd	nd	nd	nd	
4/90	nd	nd	nd	nd	nd	
5/90	nd	nd	nd	nd	nd	

nd – not detected

Blanks indicate no analysis performed

from 57 ppb to 12,000 ppb. The significance of the kerosene is discussed below.

Kerosene Tank

Two monitoring wells are placed near the former kerosene tank location, MW-5 and MW-6. However, TPH as kerosene was also detected in two other nearby wells (MW-4 and MW-8). Aromatic hydrocarbons were detected in MW-5. As discussed above, these are probably associated with the nearby former xylene tanks. Very low concentrations of aromatics were occasionally detected in the groundwater from MW-6: 0.5 ppb toluene in April and 0.5 ppb benzene in May. These concentrations are negligible.

Total petroleum hydrocarbons as kerosene were detected in all four wells in this area. Concentrations ranged from 57 ppb to 12,000 ppb. It is uncertain whether all of the TPH was released from the kerosene tank. It is possible that the TPH in the vicinity of MW-8 could have an alternate source associated with the rail car that had been used to store xylene (refer to Buckhart-Horn report). In any case, the petroleum falls within the kerosene range and should behave similarly.

Mineral Oil Tank

As mentioned above, negligible concentrations of aromatic compounds were detected in MW-6. A TPH concentration of 86 ppb as kerosene was also detected in this well on one occasion. Total petroleum hydrocarbons as mineral oil were not detected in groundwater in this area.

Gasoline Tank

On one occasion, a very low concentration of benzene (0.8 ppb) was detected in the groundwater from MW-7. No other aromatics were detected. On one occasion, a TPH concentration of 15 ppb as gasoline was detected.

No. 2 Oil/Diesel Tank

Neither aromatics (BTEX) nor TPH were detected in groundwater samples collected from MW-10.

Background/Upgradient

Low concentrations of BTEX were detected in the groundwater from MW-9. Total BTEX concentrations ranged from 0.8 ppb to 48 ppb. No TPH were detected.

5.0 Conclusions

Groundwater Technology has performed a limited hydrogeologic assessment at Scott Paper Company's Operations Facility in Chester, PA. The assessment resulted in the observations discussed below.

In the front of Buildings Nos. 20 and 21, xylenes and kerosene have been detected in the soils and groundwater. Groundwater flow in this area is obstructed by the basements of the buildings. As a result, groundwater appears to flow along the front of the buildings to the east. Two wells (MW-3 and MW-7) are located potentially downgradient of this area. The groundwater in these wells has not been impacted by xylene. It is likely, therefore, that the xylene and kerosene are currently restricted to the area in front of buildings 20 and 21. The tanks that were the source for these compounds have been removed.

In the vicinity of the waste oil tank, petroleum hydrocarbons and low levels of PCB's have been detected in the soil. The extent of the affected soil is uncertain. Apparently, a PCB-transformer was previously located near this area. This transformer and the waste oil tank have been removed. Hydrocarbons have also been detected in the groundwater in this area.

Adjacent to the No. 6 oil tank location, low concentrations of petroleum hydrocarbons were detected in the soil and groundwater. Due to access constraints, the No. 6 oil tank was cleaned and abandoned in place rather than being removed.

Near the former gasoline tank, low concentrations of petroleum hydrocarbons were detected in a soil sample. The hydrocarbons were characterized via laboratory analysis as typical of a lube oil and could not have resulted from a gasoline

release. Groundwater from this well has not been impacted. The tank previously located in this area has been removed.

The soil material at the site generally has a high percentage of silt and clay. As a result, the flow of water and any dissolved hydrocarbons through these materials is likely to be relatively slow. In addition, all sources of further hydrocarbons have been removed. There are no known groundwater users in the vicinity of the site.

APPENDIX A
FIGURES

HYDROGEOLOGIC ASSESSMENT
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June, 1990

GROUNDWATER TECHNOLOGY, INC.

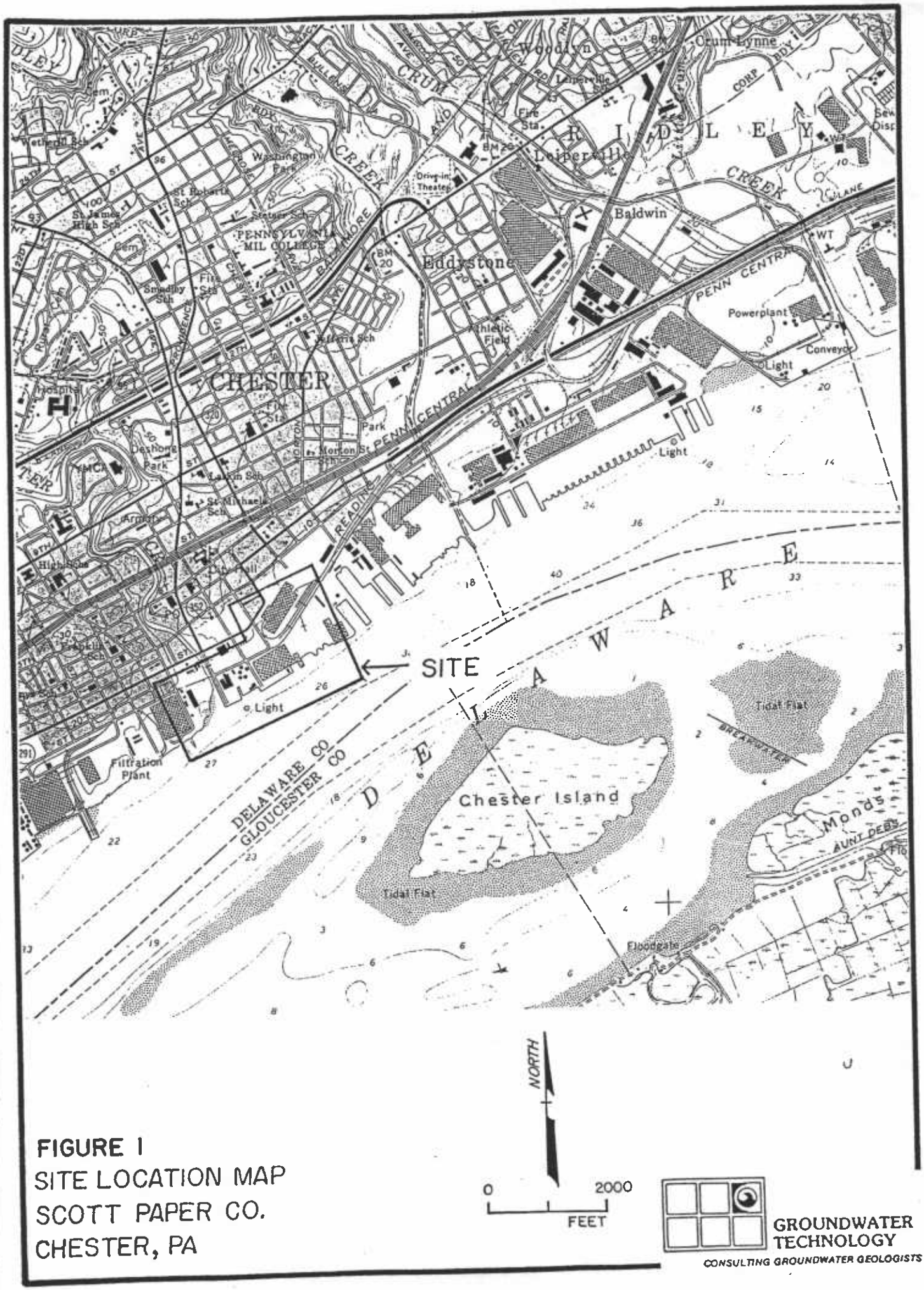

FIGURE 1
SITE LOCATION MAP
SCOTT PAPER CO.
CHESTER, PA

GROUNDWATER TECHNOLOGY
CONSULTING GROUNDWATER GEOLOGISTS

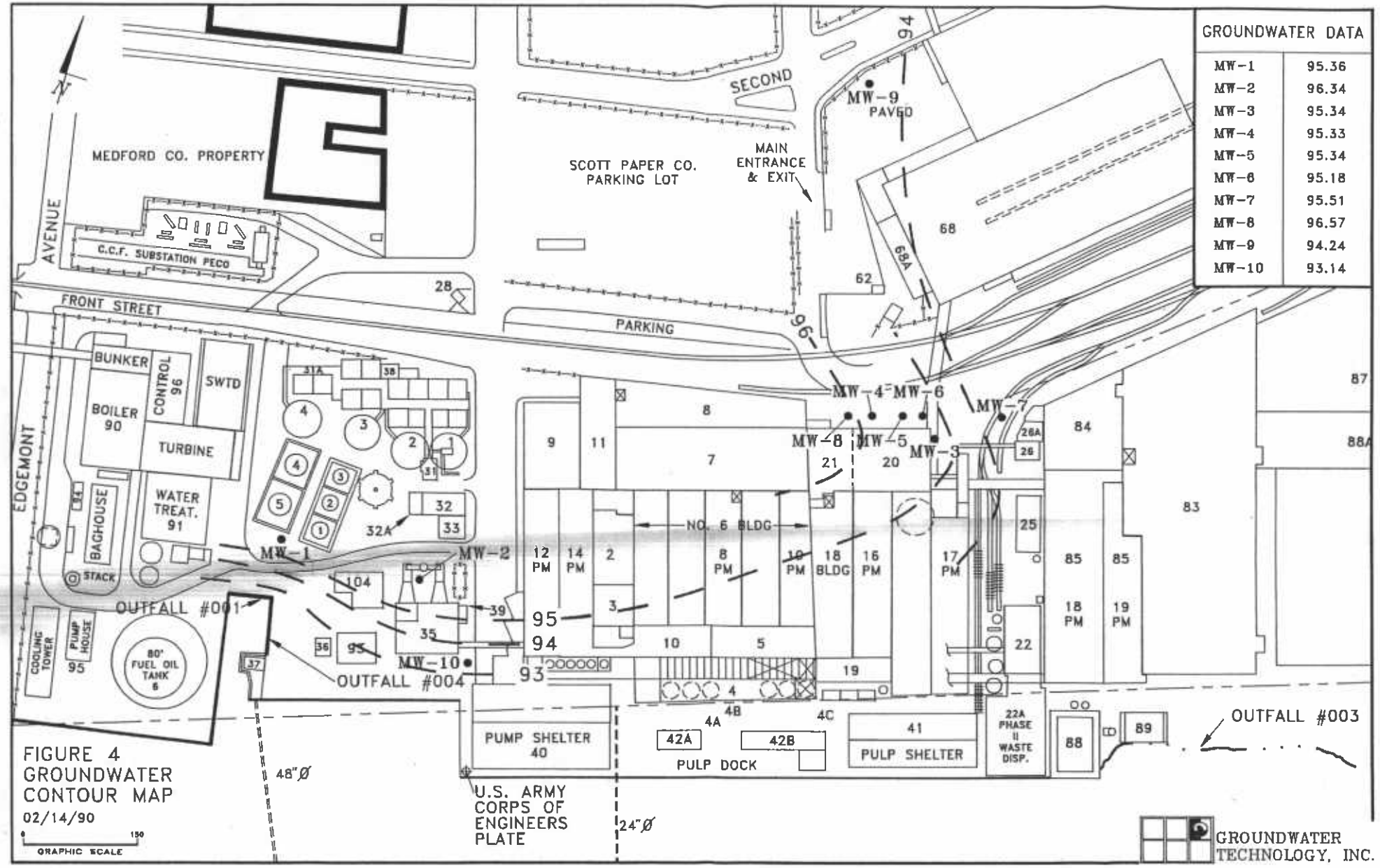

FIGURE 4
GROUNDWATER CONTOUR MAP
02/14/90